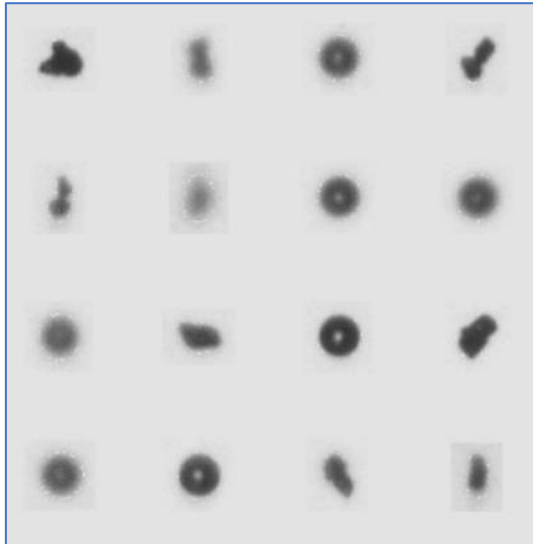
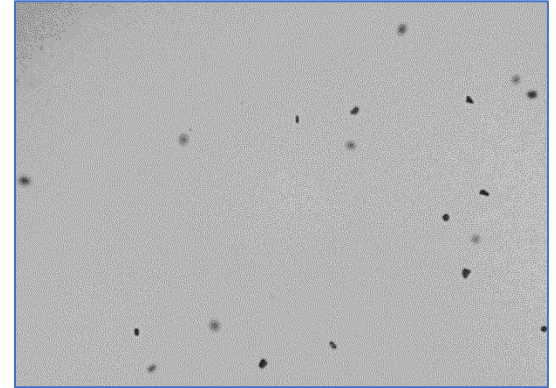




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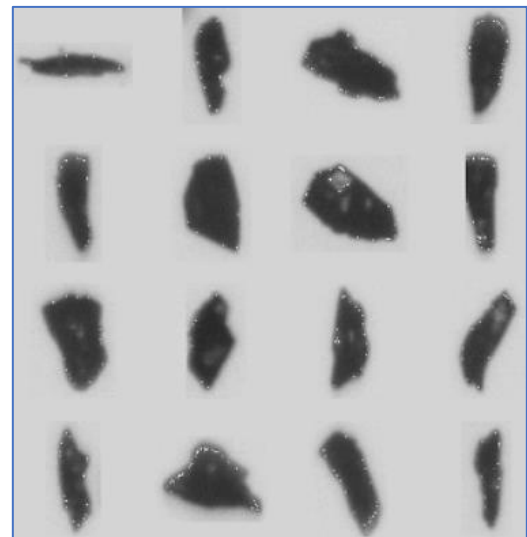
Particle Shape Analysis of Diamond Abrasives

Finely cut diamond abrasive is utilized in the manufacture of industrial drills, grinding wheels and discs, dental instruments and lapidary apparatus. The grinding tools are subsequently implemented in the production of steels, alloys, ceramics, glass, granite and other materials. Two sizes, or grits, of abrasive were examined here. A regular raw image of particles from both samples is presented below.



The first sample contains very fine sizes. There are also a few spherical bubbles present. They are between about 30 and 40 microns in diameter.

The second sample has considerably larger grains, with straight-faceted sides. Some of the sides are convex and some concave.



are



Size distribution is typically of strong interest. However, because the abrasive grains are not spherical, a singular **Size** measurement is not enough. Particle morphology measurements, comprising both **Length** and **Width**, is thus required. Particle morphology bears strongly on abrasive effectiveness. A polygon morphology characterized by sharp angles is the optimal performer.

For size calculation, the elliptical methodology is the most effective model. Although the particles are not elliptical, an ellipse can be fitted, which will yield an effective measurement of **Length**, **Width** and **Aspect ratio**. In this case, the least bounding ellipse (BE) is utilized. For morphology, the polygon model is implemented, as most particles possess a polygonal appearance, with straight sides.

The quantity of fitted polygon sides is measured as **Polygon order**, and the **Polygon angles** category describes the interior angles of the polygon. **Convexity** indicates the degree to which a particle embodies a convex morphology, in other words how well it matches the fitted polygon. A particle characterized by indented sides would embody a lower convexity than one which filled the majority of the polygon.

	Measure	Range of Acceptance
Applicable Measures	Bounding Ellipse Width	3 – 500 microns
	Bounding Ellipse Length	10 – 500 microns
	Ellipse Aspect Ratio	0 to 1.0
	Polygon Order	0 to 25
	Polygon Angles	0 to 180
	Convexity	0 to 1.0
	Smoothness	0 to 1.0

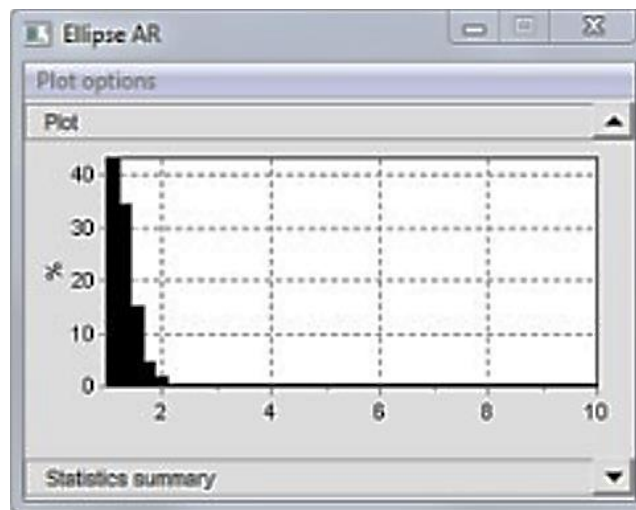
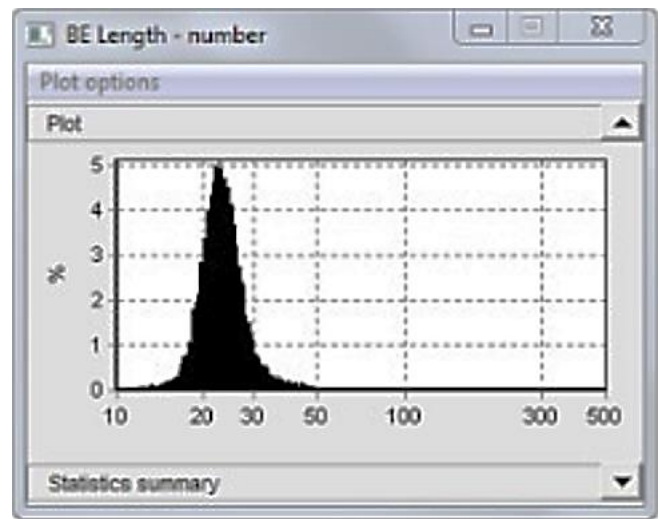
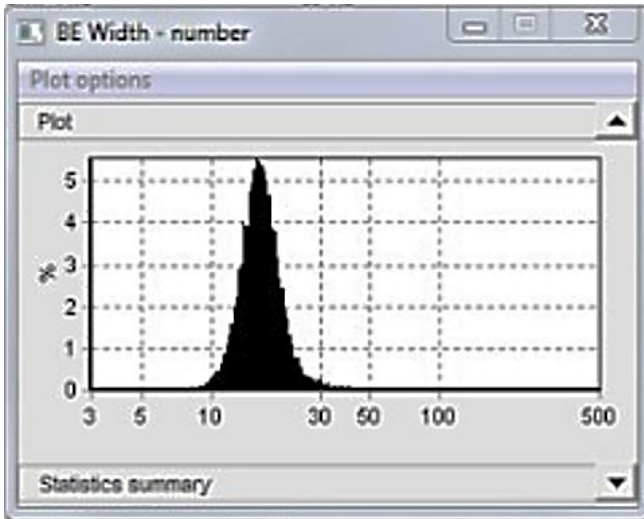
Image analysis settings with the [Pi Sentinel PRO](#) comprised minimum pixel area: 5; maximum pixel area: 50000; binary threshold: 80%; focus rejection parameter: 50; pump speed: 40%, and the option to adjust dimensions for diffraction effects was allowed.



Results

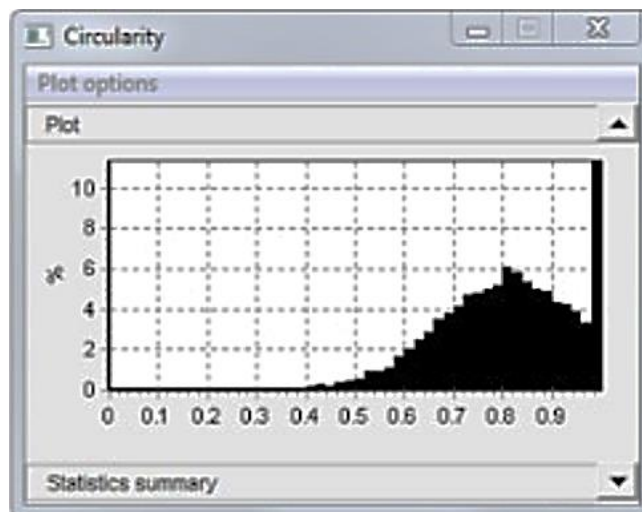
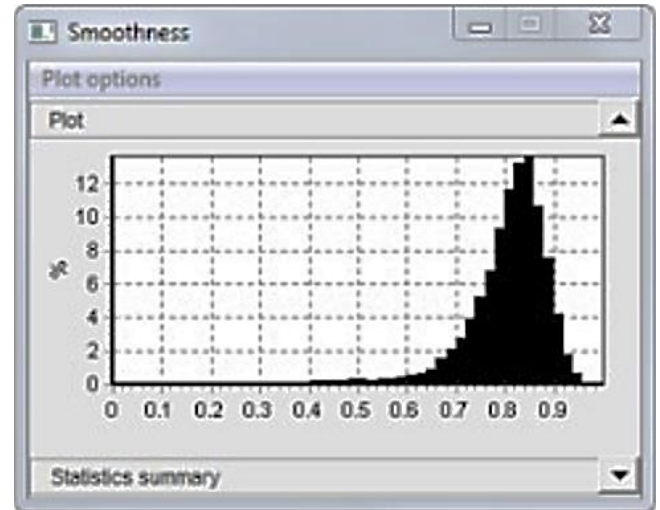
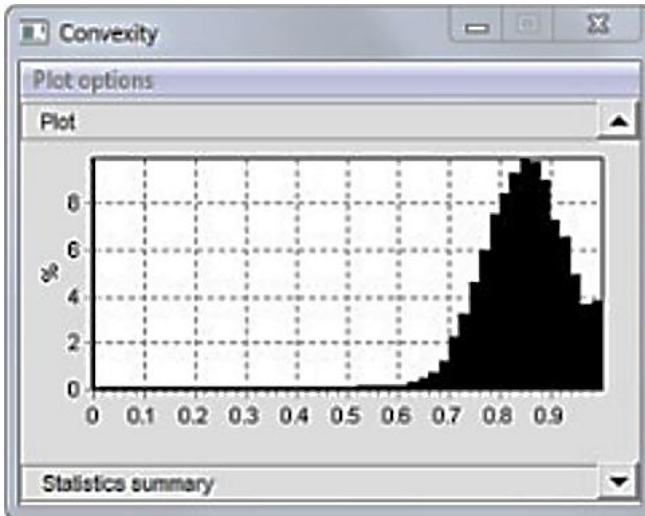
Sample 1

Approximately speaking, **Length** and **Width** (BE Width – BE Length) are typically distributed with every **Aspect Ratio** (Ellipse AR) under 2.



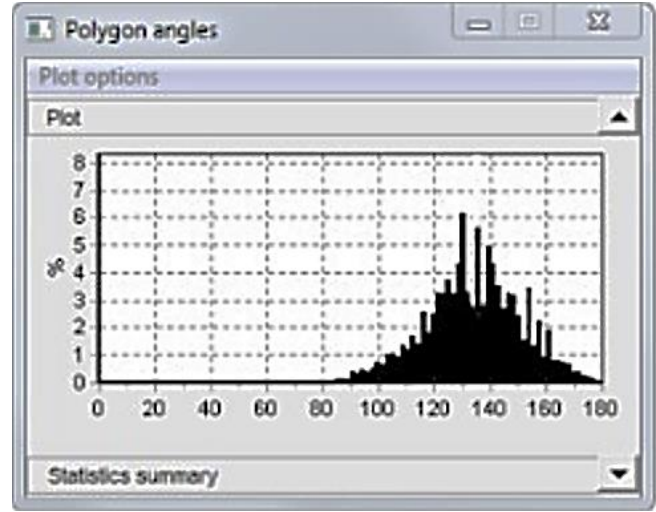
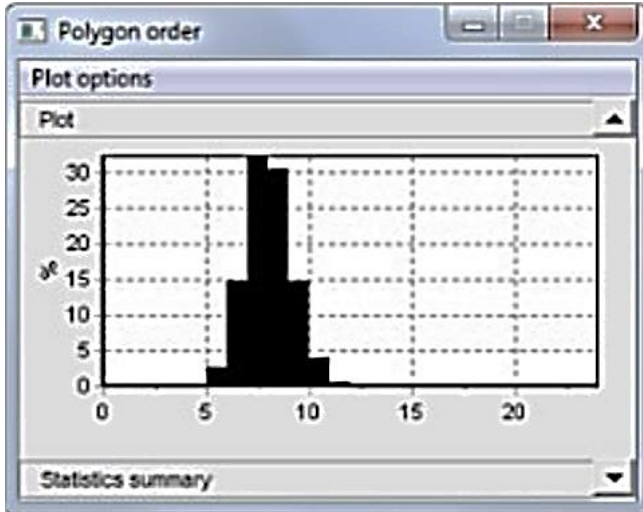


Convexity has a spread to its distribution but is fairly high. **Circularity** exhibits a spike at 1 as a result of the occurrence of the spheres.

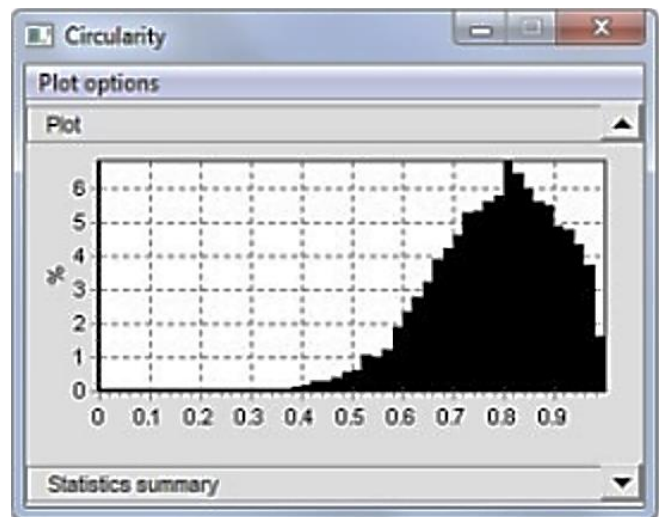
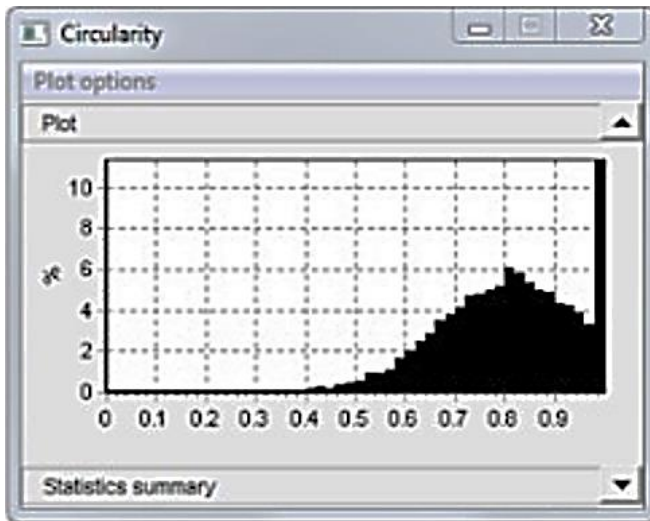




Quantity of sides (Polygon order) averages between 7 and 8. **Interior angles** (Polygon angles) are distributed around 135 degrees.



Utilizing the post-processing filter, the capacity for reanalysis of the particles, without the spheres, is enabled, by imposing an upper limit of 0.99 on circularity.

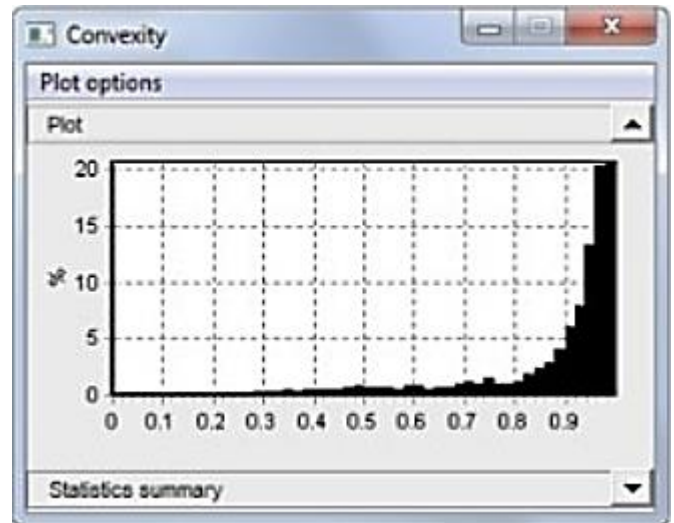
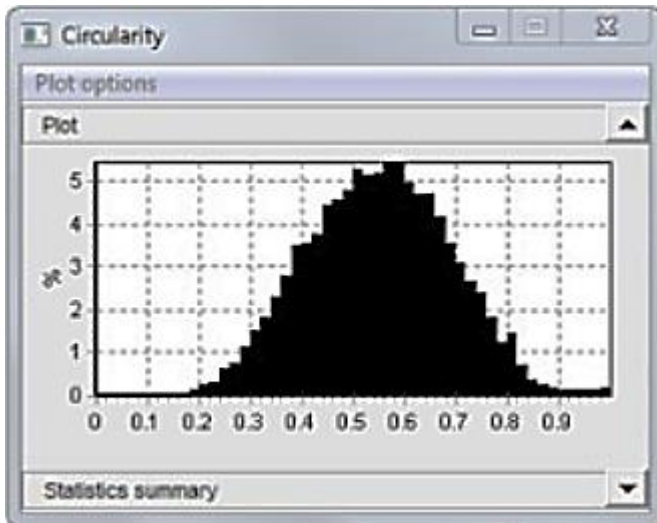
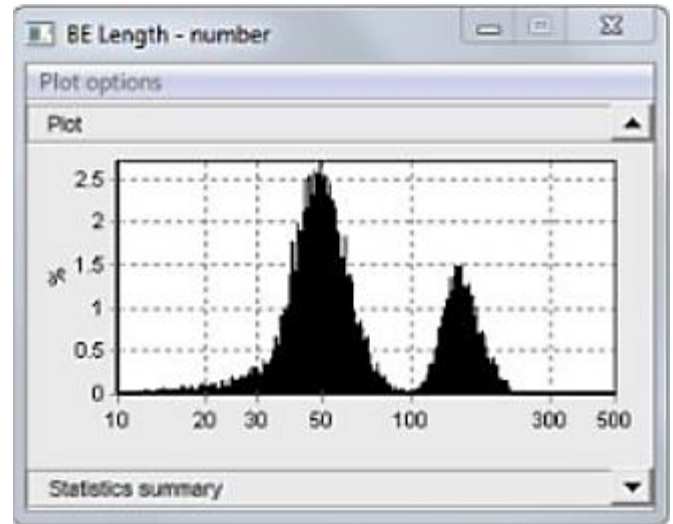
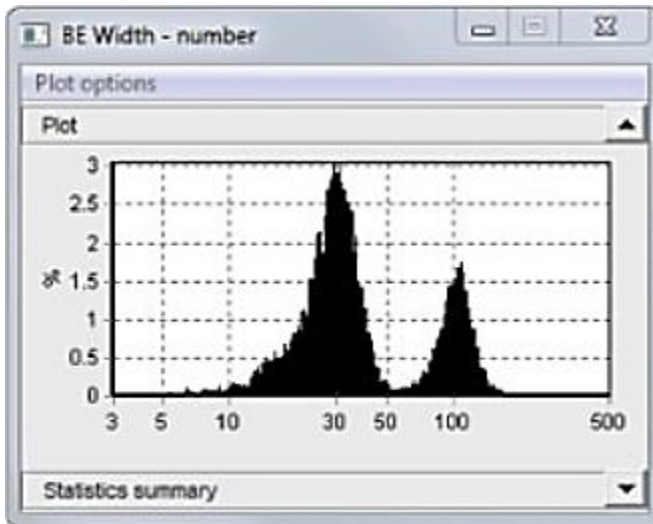


The data exhibits only minimal change, since the spheres comprise under 10% of the sample (1430 out of 15114).



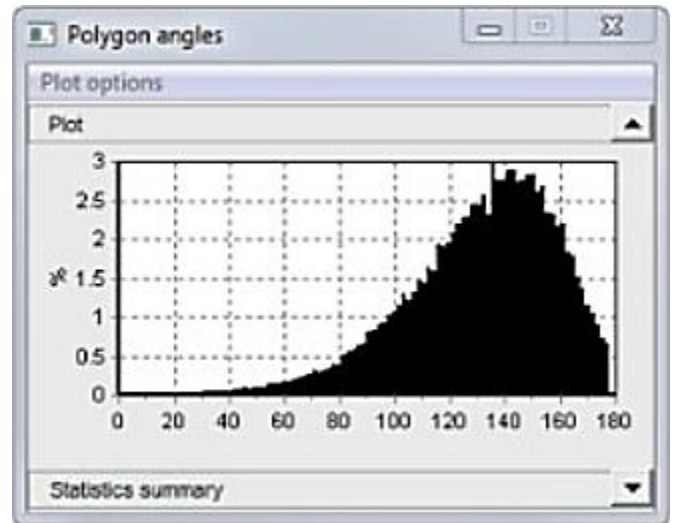
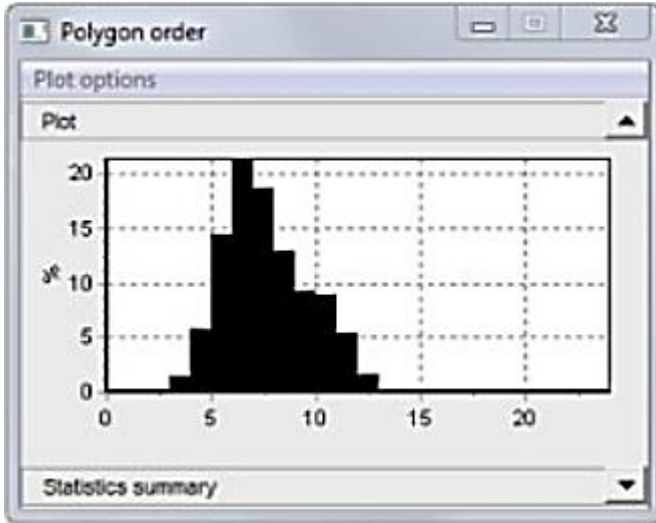
Sample 2

In the second sample, the **Bounding ellipse width** (BE Width) average increased to 28.7 microns, compared to 17.0 in the first sample. **Bounding ellipse length** (BE Length) likewise grew from 23.9 to 49.4. For these larger abrasives, both **Circularity** and **Smoothness** are smaller than the fine particles constituting the first sample.





Polygon order is roughly the same in this instance. **Polygon angles** exhibit a comparable average, but the histogram now describes a typical skewed normal distribution. A high quantity of the particles in the first sample is too fine to calculate angularity. The larger abrasives possess a higher convexity.



A third sample was generated from the first and second samples for demonstration reasons. Examination of the third mixture reveals the occurrence of the two original materials, in disparate quantities. It is possible to isolate the two components with the use of one of the Particle Insight separation techniques and correlate the results with the initial samples.

End of NOTE

